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Fuels Report

Lover's Canyon Project

**Scott River Ranger District, Klamath National Forest
Siskiyou County, California**

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Introduction

The Lovers Canyon Project is located in California on the Klamath National Forest. This analysis will focus on a project area encompassing Boulder, Canyon, and Kelsey creek drainages. The project lies within the Lower Scott River watershed which is approximately 15 miles west of Fort Jones. Elevations within the project area range from approximately 2,300 feet to about 6,700 feet. The terrain encompasses all aspects with both flat and steep terrain. Private lands adjacent to Federal ownership are present within the project boundary.

The need for action in the project area evolved primarily from changes in fire regimes (Appendix B) over the last century. Historically, mixed-severity fires in the area played a significant role in creating a high spatial complexity of vegetation, including openings of different sizes, forested stands that were generally more open and late-successional, closed-canopy forests. Fire suppression, along with other past management activities in the project area, has resulted in uncharacteristically dense vegetation and high fuel loading, a decline in wildlife forage and habitat diversity, and an elevated risk of high-severity, stand-replacing fires. The vegetation and fuels conditions are conducive to large fire growth, extreme fire behavior, and large areas of severe and intense wildfire leading to concerns over fire effects to resources (i.e. wildlife habitat, soils, hydrology, human uses and air quality), as well as public and firefighter safety.

Policy, Laws, and Direction

The following current laws, policy and direction related to fire/fuels apply to the Lovers Canyon Project:

- Klamath National Forest Land and Resource Management Plan (July 1995),
- Forest Service Manual 5100 (fire, fuels and air quality),
- Forest Service Manual 2000 (National Forest Resource Management).

Land and Resource Management Plan

The Klamath National Forest Land and Resource Management Plan (Forest Plan) provides two types of direction: Forest-wide direction (pages 4-62 and 4-63) and Management Area direction (pages 4-73 – 4-180). The project area encompasses Management Areas 5, 10, 15 and 17. The Forest-wide direction states that fuels analysis should address the accumulation of fuels over time, including fuels generated from management activities (S&G 22-16) and describe the hazard, risk and consequences of a wildfire (S&G 22-19).

Methodology

Fire behavior modeling was conducted using FlamMap. FlamMap is a fire behavior mapping and analysis program that computes fire behavior characteristics over a landscape of constant inputs of weather and fuel moisture conditions (Finney 2006). Outputs consist of fire type or crown fire potential (Scott and Reinhardt 2001) and flame length potential (Finney 1998). The dominant vegetation type from the EVEC geographic information system layer was used for this analysis. The FlamMap model assumes uniform canopy characteristics and makes independent fire behavior calculations for each raster landscape (a 90 meter by 90 meter cell). As a result of these assumptions, the model frequently under-predicts active crown fires (Fule et al. 2001; Scott and Reinhardt 2001; Cruz et al. 2003; and Stratton 2004). Weather and fuel moisture conditions were

calculated by a climatology program (Fire Family Plus) that collects historical weather data for analysis. Historical weather data was obtained from remote automated weather stations at Callahan and Collins Baldy. Ninetieth percentile weather (very dry) conditions were put into FlamMap for analysis of fire behavior potential.

Fire behavior modeling uses input variables to calculate fire behavior. The three primary variables affecting fire behavior are fuels, weather, and topography. Because fuels are the primary variable that management activity can influence, they were the main variable used in this analysis of fire hazard. Potentially combustible fuels range in type from standing live trees and brush (woody fuels) to downed woody debris that ranges from less than a quarter inch in diameter (known as 1-hour fuels) to more than three inches in diameter (1000-hour fuels). Fuel moisture content and wind speed were based on 90th percentile weather conditions (Table 1).

Table 1: Modeling inputs based on weather conditions under 90th percentile conditions*

Weather Under 90th Percentile Conditions (very dry)	
<i>Parameter</i>	<i>90th Percentile Weather Output</i>
Woody Fuel Moisture	90
Herbaceous Fuel Moisture	60
1000-Hour Fuel Moisture	7
100-Hour Fuel Moisture	6
10-Hour Fuel Moisture	5
1-Hour Fuel Moisture	4
20' Wind Speed (m.p.h.)	9

Assumptions important to Analysis:

- Fire behavior modeling uses input variables to calculate fire behavior. The three primary variables affecting fire behavior are fuels, weather and topography. Because fuels are the primary variable that management activity can influence, they were the main variable used in this analysis.
- Understanding the conditions under which wildfires are managed and suppressed helps frame the analysis required for understanding conditions that support wildfires. An assessment of historical wildfire season parameters helps to frame what inputs for the analysis are required.
- Fire season is the period of most common fire start occurrence and when spread is most likely. The primary fire season period for the project area is mid-May to the end of October. Wildfires do occur outside of this period, but are not often problematic for fire

suppression efforts and are outside this analysis process. Weather patterns such as drought or rain can lengthen or shorten any given fire season.

- The fire season can be defined by four primary fire behavior/fire danger periods: low, moderate, high, and very high. Low and moderate is not included in this analysis because wildfire events are not common and the amount of effort needed to suppress fires is typically low. High to Very high fire danger periods occur under 90th percentile weather conditions, or weather conditions that make up 10% of the days of the historical fire seasons, and large fire growth can generally be expected during these days. For the analysis of the Lovers Canyon Project, a 90th percentile weather scenario will be calculated for analysis based on historical weather from Remote Automated Weather Stations from May 15 to October 31.

Fire Type (under 90th Percentile Condition)

Fire type is a measure of how severe a fire may become under specified conditions. Canopy characteristics (e.g. canopy base height, canopy bulk density, stand height, and foliar moisture content), ladder fuels, and fuel loading are all factors that determine fire type. The model assumes uniform canopy characteristics and makes independent fire behavior calculations for each raster landscape (90 m X 90 m cell). As a result of these assumptions, the model frequently under-predicts active crown fires (Fule et al., 2001; Scott and Reinhardt, 2001; Cruz et al., 2003; and Stratton, 2004).

Flame Lengths under 90th Percentile Weather Conditions

Flame Lengths serve as a measure of how intense or severe a fire may become and as a proxy for ease of fire suppression to model and predict fire behavior. Flame lengths are described in the Fire Management Plan and Appendix B of the Fire line Handbook (NWCG 2006) and are defined in Table 2.

Current Condition Fire Regime Impacts to Vegetation

The fire regime is the most widespread and dynamic disturbance regime affecting the analysis area. Appendix B discusses the Fire Regime condition class and the Lovers Canyon Project Area. Numerous fire starts occur within the analysis area every year. Fires occurring in the area affect vegetation communities with varying severities. Patterns of fire severity can be attributed to vegetation type, solar radiation, weather patterns, and slope positions. Upper slopes, ridgetops, and south and west facing aspects typically experience higher fire severity. Lower slopes and north and east facing aspects typically experience lower fire severity. These areas typically have multi-aged stands and burn with less frequency. With lower fuel loadings, landscape features such as streams and ridgetops are often sufficient to impede fire spread.

Analysis Indicators and Measures

This report discusses the historic role of fire in the Lover's Canyon Project, and how current conditions reflect a departure from historic fire return intervals. The analysis indicators will be used to compare the current conditions to the no action alternative, alternative 2, and alternative 3 to depict an overall trend towards or away from the desired condition of the project area relating to fire and fuels.

Analysis Indicators

- Fire Type – Fire type is an indicator on whether a fire is likely to stay on the surface or move through the crowns given a set of stand and burning conditions.
- Flame length potential - Flame length is an indicator of surface fire intensity. Flame length is defined as the distance along the slant of the flame from the midpoint of its base to its tip.
 - Fire behavior potential on dominant vegetation type and size class category – This is an indicator for potential fire effects to vegetation type and size class under specified modeling conditions.

Measures

Fire Type

Fire type is a measure of whether a fire is likely to stay on the surface or move through the crowns given a set of stand and burning conditions. This measure is useful for analyzing the risk of losing a forested overstory to wildfire. Extensive crown fires can be particularly damaging in vegetation types that are not adapted to respond to high intensity crown fires. Fire type is defined by the following categories:

- Surface fire – The fire remains on the forest floor. The combination of surface fire intensity and ladder fuels is not sufficient to move a fire into the crowns under the defined burning conditions.
- Passive crown fire – Individual tree or group torching occurs. The combination of surface fire intensity and ladder fuels allows for movement into the crowns under the defined burning conditions, but canopy bulk density is too low for fire to spread through the crowns under the projected wind speeds.
- Active crown fire – The combination of surface fire intensity, ladder fuels and canopy bulk density allows fire to move into, and spread through, the crowns under the defined burning conditions.

Flame Length Potential

One of the primary metrics used for assessing fire hazard or fire behavior is flame length. Flame length is an indicator of how hot or severe a fire can become (i.e. a measure of heat output). This metric provides a means for assessing the potential for fires becoming difficult to suppress or

contain, the potential to threaten communities at risk (i.e. wildland urban interface), and the potential to threaten resource values (e.g. wildlife habitat, soil stability, human uses, hydrology, air quality).

Table 2: Flame length potential and fire line intensity.

Flame Length (ft.)	Description
0-4'	<i>Low</i> -- Fires can generally be attacked at the head or flanks by persons using handtools. Handtools should hold the fire.
4-8'	<i>Moderate</i> -- Fires are too intense for direct attack on the head by persons using handtools. Handline cannot be relied on to hold the fire. Equipment such as dozers, engines and retardant aircraft can be effective.
8-11'	<i>High</i> -- Fires may present serious control problems – torching out, crowning and spotting. Control efforts at the head of the fire will probably be ineffective.
Greater than 11'	<i>Very High</i> -- Crowning, spotting, and major runs are common. Control efforts at the head of the fire are ineffective.

Fire Behavior Potential on Dominant Vegetation Type and Size Class

A primary concern within the project area is fire effects potential to vegetation. This measurement indicator displays flame length potential on dominant vegetation types and size classes. The definitions of flame lengths and fire line intensity can be used to describe potential fire effects to vegetation categories and size classes for analysis. An analysis was conducted to determine current fire behavior potential on dominant vegetation communities and size class. This was done to get a better understanding of potential fire effects on current vegetation types and size class distribution.

Spatial and Temporal Bounding of the Analysis Area

This report looks at measurement indicators of fire type (surface fire, passive crown, and active crown fire), flame length potential and fire behavior potential on vegetation at the treatment level scale and project area scale over a 20 year period as a means to quantify a comparison of alternatives including the effects of past, current, and reasonably foreseeable future actions. The spatial bounds for this analysis are the project boundary. Treatment level modeling is only specific to those areas of Forest Service ownership that the action alternatives considers against the no action alternative. Project area and treatment area within the project area was modeled to show a comparison of acreage change or effectiveness of treatments (Tables 3-6, Tables 9-12) for both flame lengths and fire type. Fire behavior on dominant vegetation and size class was

modeled and compared only throughout the project area (Tables 7-8, Tables 13-16 In treatment level modeling; assumptions (Appendix A) may slightly alter fire behavior outside of the treatment area, however the majority of alteration will be shown within the treatment area.

It is also important to state the proximity of private property sections within the analysis area. The effects of treatments for the Lover's Canyon project and past, current, and foreseeable future actions will be analyzed.

The analysis will show current conditions, 5 years post treatment and 20 years post treatment. Short term is 5 years after treatment and long term is 20 years after treatment. After approximately 20 years, modeling indicates a potential need for maintenance to consume additional surface fuels.

Affected Environment

Background

Fire has played a major role in shaping vegetation composition and structure in the project area (Agee 2007, Skinner *et al* 2006, Taylor and Skinner 1998). The analysis area extends through the montane ecological zones and is characterized by frequent fires of low- to-mixed severity (Skinner *et al.* 2006, Taylor and Skinner 1998). Lightning, European settlers, and American Indian-ignited fires were the primary factors shaping the vegetation (Taylor and Skinner 1998).

Stand and vegetation structures along with severity patterns within this regime are highly dependent on the complex combination of topography, vegetation and climate in the area (Agee 2007, Skinner *et al.* 2006). Generally, upper slope positions and south and west facing slopes burn at higher frequencies and with higher severities than lower slope positions and north and east facing slopes (Weatherspoon and Skinner 1995, Taylor and Skinner 1998, Skinner *et al.* 2006, Jimerson and Jones 2003). Spatial variation in soil productivity, in conjunction with steep gradients of elevations and aspects, controls the rates of fuel accumulation (Skinner *et al.* 2006). Disturbance history affects the fuel profile and is linked to severity patterns on the landscape (Miller *et al.* 2009 and Alexander *et al.* 2006).

A landscape consisting of steep and complex terrain as well as dissected ownership creates a unique interaction with fire weather and elevation during the hot, dry summers when a high pressure prevails and smoke does not dissipate; this often results in temperature inversions. While these inversions can lead to benign fire behavior, they can also create public health issues and concerns over high densities of smoke particulates that cover large areas and that can persist for many days. When the temperature inversions are broken by high winds, fire behavior can increase significantly, resulting in large areas of high-severity fire.

Numerous fire starts still occur in the watershed analysis area. However, with the onset of fire suppression in the early 1900s and increased effectiveness of suppressing fires with mechanized equipment (fire engines, dozers, aircraft, etc.) in later years, most of the fires are kept small. As a result, forest vegetation has changed from a heterogeneous pattern to a more homogeneous pattern of smaller openings in a matrix of denser forests (Skinner *et al.* 2006). Therefore, one of the most extensive problems related to the health of this watershed is the over-accumulation of vegetation and fuel loading due to a lack of disturbance from fire. Although severity patterns are still largely dependent on physical factors (i.e. slope position, aspect, slope percentage, elevation, etc.), the current vegetation composition and structure have created conditions that increase the

likelihood of larger areas of intense and severe fire (Skinner *et al.* 2006, Taylor and Skinner 2003, Scott and Reinhardt 2001).

Existing Condition

The existing condition in the project area evolved primarily from changes in fire regimes over the last century. Historically, mixed-severity fires in the area played a significant role in creating a high spatial complexity of vegetation, including openings of different sizes, forested stands that were generally more open and late-successional, closed-canopy forests. Fire suppression - along with other past management activities in the project area - has resulted in uncharacteristically dense vegetation and high fuel loading, a decline in wildlife forage and habitat diversity, and an elevated risk of high-severity, stand-replacing fires.

Fire suppression has largely eliminated large fires in the project area. As a result, the project area is severely departed from historic fire return intervals. In other words, most of the Lovers Canyon Project area has missed four or more fire return intervals since suppression began on the Klamath National Forest.

The winter of 2016-2017 resulted in storm damage throughout the project area. Heavy precipitation caused multiple new active landslide features to develop, these features affected both roads and proposed treatment units within the project area. Nine new active features, totaling about 15 acres, developed that overlap with proposed treatment units during the winter of 2017. The distribution of fuel loading has changed within some of these new active features with more large fuels on the ground while other areas are unstable but the majority of existing trees are still standing. The small acreage affected by new active features is not enough to cause a change to the baseline conditions of any fuels analysis indicators for this project area.

Climate

The climate of the project area is best described as Mediterranean, characterized by wet, cool winters and dry, warm summers (Skinner *et al.* 2006). The project area is located 15 miles west of Fort Jones, California, which receives a mean annual precipitation of approximately 30 inches. Precipitation primarily occurs from November 1 through April 30, however, summer thunderstorms are common and can release significant localized rain. Thunderstorms can also be dry with conditions that encourage fire ignition and spread from lightning strikes, with the summer of 2014 being the latest example of this pattern near the project area.

Climate Change

Local data derived from five weather stations in the Klamath Mountains were used to evaluate climate trends over an approximate 100 year period (Butz and Safford, 2011). The data suggests that mean annual temperature has increased by approximately 2° F and precipitation is near the transition zone between areas of higher and lower precipitation (see figure 1 of Butz and Safford, 2011).

Fire and Fuels under Climate Change

Westerling *et al.* (2006) showed that increasing frequencies of large fires (>1000 acres) across the western United States since the 1980's were strongly linked to increasing temperatures and earlier spring snowmelt. Northern California forests have had substantially increased wildfire activity, with most wildfires occurring in years with early springs (Westerling *et al.* 2006). This increase is likely attributable to both climate and land-use effects. Large percentage changes in

moisture deficits in Northern California forests, according to Westerling et al. (2006), were strongly associated with advances in the timing of spring, but this area also includes substantial forested area where fire exclusion, timber harvesting, and succession after mining activities have led to increased forest densities and fire risks (McKelvey et al. 1996).

Miller et al. (2009) found no temporal trend in the annual proportion of fire area burning at high-severity within fires >400 hectares occurring on the four National Forests of Northwest California during the period 1987-2008. However, mean and maximum fire size and total annual area burned all increased over the period from 1910 to 2008 and regional fire rotation fell to 95 years by 2008. During 1987-2008, Miller et al. (2009) found that the percentage of high-severity fire in conifer-dominated forests of smaller average diameter and lower percent cover was generally higher than in forests of larger diameter and higher cover. For areas that burned more than once during this period, severity (a measure of the effect of fire on vegetation) in conifer and hardwood forests was higher the second time burned versus the first time burned, regardless of tree density and size class. Closed forests of medium and large diameter trees that had previously burned between 1921 and 1986 burned at lower severities than similar forests that had last burned before 1921. Miller et al.'s (2009) data showed that years with larger fires and greatest area burned were produced by region-wide lightning events, and characterized by less winter and spring precipitation than in years dominated by smaller human ignited fires, but the percentage of high-severity fire was generally less in region-wide lightning events. (Butz and Safford 2011)."

Fire History

According to the Klamath National Forest GIS layers, an average of approximately 1 fire per year or 21 fires over the past 20 years have occurred within the project boundary. Of the 21 fire starts, 5 were human starts while 16 were caused by lightning. The majority of the project area has not seen fire over the past 100 years. The Kelsey Fire of 1987 and Happy Camp Complex of 2014 affected the Kelsey drainage of the project area. Prescribed burning occurred on several acres of this landscape under a previous NEPA decision named "Cannon/Cub". This prescribed burning included broadcast burning, understory burning, and pile burning. Much of this activity is still visible in the project area. Some of the prescribed activities had positive effects and would still be considered as an effective treatment or still meeting desired condition of low flame lengths and surface fire. However, some of the activities had more severe fire effects as to mortality of the past timber stand that has responded with accumulations of heavy dead and downed materials and tall dense brush. These areas would show very high flame lengths and passive to active crown fire conditions. Some of the areas in managed stands that were thinned and piled with a follow-up pile burn are hardly recognized as thinned treatments as hardwoods, brush, and conifers have closed the canopy gaps and no longer meet desired conditions.

The Deep Fire was detected in early September 2017 after a series of lightning storms moved through the project area. The fire reached about 100 acres in size and burned primarily at low burn severity, consuming mostly ground fuels; a few snags and concentrations of heavy fuels in small pockets. About 30 acres of the Deep Fire are within the Lover's Canyon Project boundary, the fire did not burn into or directly adjacent to any proposed treatment areas. The Deep Fire was controlled with hand lines and the use of aviation resources, there were no equipment constructed lines utilized for suppression of this fire.

Fire Risk

Fire risk is defined in the Forest Plan as the probability of a fire start occurring over a ten year period for a given thousand acre area. Fire risk is based on the Klamath National Forest GIS layers for fire occurrence records within the analysis area. The risk classification within the Forest Plan is as follows:

- Low Risk = 0 to 0.49: Less than 0.5 fires expected to occur per decade for every thousand acres in the area being analyzed.
- Moderate Risk = 0.50 to 0.99: Between 0.5 and 0.99 fires expected to occur per decade for every thousand acres in the area being analyzed.
- High Risk = At least one fire expected to occur per decade for every thousand acres in the area being analyzed.

Within the project boundary (11,810 acres) 21 fire starts occurred over a 20 year period analyzed (1995 to 2015). The risk value formula is $R = \{(x/y) 10\}/z$

Where:

x = fire starts (21)

y = period analyzed (20 years)

z = number of acres analyzed (11,809 displayed in thousands = 11.8)

Risk rating = $\{(21/20) 10\}/11.8 = 0.89$ (Moderate Risk)

The project area has a moderate fire risk value. The primary source of ignition (approximately 76 percent) is lightning caused while approximately 24 percent was human caused ignitions.

Analysis Indicators under the Affected Environment

Current vegetation patterns are also attributed to disturbance history. Much of the analysis area (nearly 100 percent) has been fire free over the past 20 years. As a result, the build-up of ladder and surface fuels has increased the probability of high severity stand replacing fire. Although current vegetation and severity patterns are largely dependent on factors mentioned above, large patches of high severity fire have been observed in areas that typically burned at low severity in recent burns near the project area. Therefore, current vegetation patterns and seral stage distribution have changed significantly since the onset of the fire suppression era approximately 100 years ago.

As a result, fire adapted mixed conifer stands and understory shrub communities dominate such areas. Current vegetation patterns are also attributed to disturbance history. Much of the analysis area (nearly 90 percent) has been fire free since recorded fire history of the early 1900's. As a result, the build-up of ladder and surface fuels has increased the probability of high severity stand replacing fire. Although current vegetation and severity patterns are largely dependent on factors mentioned above, large patches of high severity fire have been observed in areas that typically burned at low severity in recent burns near the project area (2014 Happy Camp

Complex). Therefore, current vegetation patterns and seral stage distribution have changed significantly since the onset of the fire suppression era approximately 100 years ago.

Desired Condition

The desired condition includes the maintenance and restoration of forest conditions that are resilient to disturbances of high fire behavior and fire effects. This includes moving stands toward more sustainable conditions from effects to wildfire. Developing and maintaining stand conditions will result in reduced fire behavior and effects, creating a more fire resilient landscape. Due to fire characteristics on different aspects, south and west slopes and drier areas would be more open due to more frequent and intense fire regimes while north and east slopes would have denser vegetation relative to drier sites.

The desired fire behavior after treatment is to have low to moderate intensity fires under 90th percentile weather conditions, primarily consisting of flame lengths less than 4 feet. With a surface fire and flame lengths less than 4 feet, fires can generally be attacked at the head and flanks by firefighters using hand tools.

Environmental Consequences

The storm damage and Deep fire events of 2016 and 2017 did not change the baseline condition of the fuels analysis indicators for this project area, and therefore the effects of alternatives 1, 2, and 3 as described below are unchanged from the minor additive effects from these events.

Alternative 1

Direct Effects and Indirect Effects

Without the influence of silviculture treatments and fire under prescribed conditions to restore and maintain vegetation diversity, many stands are unlikely to develop into late-successional habitat due to stand stagnation and low resilience to the current fire regime. Other stands are likely to continue to lose their structural and compositional diversity. Re-introducing fire to the project area under prescribed conditions would provide the benefits associated with low-to mixed-severity fires (e.g. fuels reduction and vegetation diversity) while minimizing the adverse effects often resulting from uncontrolled high-severity wildfires (e.g. effects to soils, wildlife habitat, infrastructure and air quality).

Under the no action alternative, there would be no direct effects. The continued level of management and use would occur. A total of approximately 4,444 acres of proposed treatments would not occur. Fire behavior potential (flame length potential and fire type) and fire effects to vegetation under 90th percentile weather conditions would remain as described in the existing condition. Surface, ladder, and crown fuels would continue to accumulate and would likely increase fire behavior in the project area over time.

For ease in comparison of alternatives, measurement indicators are displayed in the tables below to show flame lengths, fire type, fire behavior potential on dominant vegetation type and size class category. For ease of comparison both the entire project area (about 11,810 acres) and treatment areas (4,444 acres) were analyzed for the no action alternative. See the proposed action (alternative 2) section of the Lover's Canyon Scoping Outcome Summary for a summary of treatment areas within project.

Fire Type

Table 3. Fire Type displayed in acres – No Action within the project boundary

Percentile Weather	Surface Fire	Passive Crown Fire	Active Crown Fire
90th Percentile	1,777 (15%)	9776 (83%)	257 (2%)

Table 3 displays the current condition under 90% weather within the entire project boundary for Fire Type. The majority of the project models to show passive and surface fire type. As timber stands continue to grow/connect and surface ladder fuels continue to accumulate; it would be expected that there is a higher potential of moving fire type from surface to passive and active crown fire.

Table 4. Fire Type displayed in Acres – No Action within the proposed treatment area

Percentile Weather	Surface Fire	Passive Crown Fire	Active Crown Fire
90th Percentile	1098 (25%)	2983 (67%)	363 (8%)

Table 4 is similar to Table 3 above; addressing the current condition under 90% weather within the treatment units of the project boundary.

Flame Length Potential

Table 5. Flame Length Potential in acres – No Action within the project boundary

Percentile Weather	Low (0-4')	Moderate (4-8')	High (8-11')	Very High (>11')
90th Percentile	3,056 (26%)	1,498 (13%)	1,277(11%)	5,979(50%)

Table 5 displays the current condition under 90% weather within the entire project boundary for flame lengths. Flame lengths are shown in 4 categories from low to very high. Certain fuel loadings and fuel models have materials such as brush and continuous slash accumulations that show higher flame lengths. These fuel models in the project area are referenced in Appendix A, Table A-2. Areas of the project that have a more open type of timber stand or less accumulations of fuels show lower flame lengths. As fuels continue to accumulate there is a higher potential of increasing flame lengths which could lead to undesirable effects if a wildfire were to occur.

Table 6. Flame Length Potential in acres – No Action within the proposed treatment areas

Percentile Weather	Low (0-4')	Moderate (4-8')	High (8-11')	Very High (>11')
90th Percentile	1118 (25%)	497 (11%)	860 (19%)	1969 (45%)

Table 6 is similar to Table 5 above; addressing the current condition under 90% weather within the treatment units of the project boundary.

Fire Behavior on Vegetation Type and Size Class

Table 7: Fire behavior potential (acres by flame length) by dominant vegetation type under 90th percentile weather conditions in the project area- No Action within the project area.

Dominant Vegetation Type	Low (0-4 feet)	Moderate (4-8 feet)	High (8-11 feet)	Very High (greater than 11 feet)
Annual Grass	8	16	14	25
Barren	90	0	0	0
Douglas Fir	228	168	127	1219
Montane Chaparral	142	35	53	56
Montane Hardwood Conifer	120	61	92	516
Montane Hardwood	29	10	13	71
Montane Riparian	40	2	12	12
Perennial Grass	7	3	6	19
Ponderosa Pine	23	7	21	68
Red Fir	419	130	29	103
Subalpine Conifer	30	13	0	0
Sierran Mixed Conifer	1,020	752	739	3267
Urban	30	0	10	4
White Fir	888	282	194	573
Total	3074	1479	1310	5933

The dominant vegetation type from the EVEG GIS layer was used for this analysis.

Table 8: Fire behavior potential (acres by flame length) by tree size class under 90th percentile weather conditions in the project area- No Action within the project area.

Size Class (diameter)	Low (0-4 feet)	Moderate (4-8 feet)	High (8-11 feet)	Very High (greater than 11 feet)
1-5.9 inches	239	56	205	165
6-10.9 inches	232	72	142	426
11-23.9 inches	1447	637	620	2677
Greater than 24 inches	943	675	253	2987
Total	2861	1440	1220	6255

Tables 7 and 8 display the current condition under 90% weather within the project boundary. The dominant vegetation and size class are categorized from low to very high flame lengths. A high percentage of the landscape in this project is typed as Sierra Mixed Conifer with the majority in Very High flame length category.

Cumulative Effects

Vegetation structure will continue to change over time (20 years), leading to increased fire hazard as stands continue to grow denser and fuels loading increases. As a result, fire type, flame length potential, and fire effects to vegetation is also likely to increase. Two current projects adjacent to the Lover's Canyon analysis area will have an effect to large scale fire across the landscape. Fire starts within the Lover's Canyon may utilize the adjacent projects as strategic areas to slow or impede fire progress. These projects are the Westside Fire Recovery and Scott Bar Mountain Underburn and Habitat Improvement. Generally these two projects have fuels modification in the form of prescribed burning that will reduce adjacent fuels and provide areas that are more likely to have effective fire suppression response. However, the project area of Lover's Canyon will continue to be at risk to larger wildfire with damaging mortality to existing stands under the no action alternative.

Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

The no action alternative would not contribute to the desired condition or purpose and need of the project outlined by regulatory direction and Klamath National Forest Land Management Plan (USDA 1995). In addition, the recommendations within the Lower Scott Watershed Assessment would not be met.

Summary of Effects

A total of approximately 4,444 acres of proposed treatments would not occur. Forest stands in the project area, which can be characterized as uniform and heavily stocked (Lover's Canyon Silviculture Report 2016). Fire behavior potential (flame length potential and fire type) and fire effects to vegetation under 90th percentile weather conditions would remain as described in the existing condition; primarily consisting of fire behavior potential that would not meet desired conditions or purpose and need. Surface, ladder, and crown fuels would continue to accumulate and would likely increase fire behavior in the project area over time.

Effects Common to Alternatives 2 and 3

The difference between alternatives 2 and 3 is not significant based on the analysis of the flame lengths and crown fire potential throughout the landscape within this project. The change of skip areas incorporated into prescriptions could lead to differences in fire behavior and effects within individual stands between alternatives, but would have little change to fire resiliency over the landscape. Longevity of stands being resilient to wildfires would benefit from more removal of fuel in Alternative 2, however the measureable difference on the landscape is too slight to model. To understand the changes to the treatments refer to the description of alternatives in the Lover's Canyon Scoping Outcome Summary. For these reasons, the direct, indirect, and cumulative effects for fuels are the same for both alternatives 2 and 3.

Direct and Indirect Effects

Under the action alternatives, a total of about 4,444 acres are identified for treatment including 2,223 acres of prescribed under burning. After the stands proposed for silvicultural treatments are thinned, they would be susceptible to the effects of wildfire until surface fuels are treated through follow up fuels work. Generally, fuels treatments (underburn, handpile and burn) would occur within 3 to 5 years after silviculture treatments have been implemented.

Modeling indicates that the majority of the treatment area would meet desired conditions as described in the affected environment section above in the short term and slowly trend back toward existing conditions in the long term over the modeled 20 year period. Ladder and crown fuels would be reduced through thinning of the stands. Activity fuels (slash generated from harvest and thinning activities) would be treated through a variety of methods including yarding methods, and prescribed fire techniques such as broadcast burning and piling and burning. The reduction of surface fuels would reduce the potential flame length within the proposed treatment units. This when combined with the raising of the canopy base heights by reducing the ladder fuels would in turn, reduce the ability of a fire to transition into a crown fire. As a result, fire effects in treated units would be reduced in all vegetation types and size classes.

Roadside and fuelbreak treatments will allow for non-commercial thinning, and removal of all hazard trees as set forth in the Forest Service Region 5 Hazard Tree Guidelines (Angwin et al. 2012). Modeling indicates that roadside and fuelbreak treatments will reduce flame lengths and reduce the threat of active crown fire in the short term. Without further treatments, modeling indicates conditions after 20 years slowly returning towards current conditions. In general, roadside treatments were designed to provide safer access (ingress/egress) for community members and firefighting resources. Roadside treatments also focused attention on creating small scale fuel breaks across the landscape to help slow fire progress, and to give a location to secure a prescribed burn.

Thinning of overstocked small-diameter understory stands would reduce the ladder fuels allowing fire to remain in the surface fuels, and reducing the potential for crown fire. Suppression operations would continue to occur, however, fire behavior modeling indicates the proposed action would keep the fuels profile at a level that reduces fireline intensity allowing suppression resources to more safely use direct suppression tactics on a much larger percentage of the project area.

Fire Type

Table 9. Fire Type Displayed in Acres – Alternatives 2 and 3- Within the Project Boundary

Fire Type in Acres – Short Term (5 Years) Post Treatment			
Percentile Weather	Surface Fire	Passive Crown Fire	Active Crown Fire
90 th Percentile	5141 (44%)	6607 (55%)	62 (1%)
Fire Type in Acres – Longer Term (20 Years) Post Treatment			
Percentile Weather	Surface Fire	Passive Crown Fire	Active Crown Fire
90 th Percentile	2887 (24%)	8861 (75%)	62 (1%)

Table 9 displays the post treatment condition under 90% weather within the entire project boundary for Fire Type. The majority of the project models to show surface and passive fire type. As timber stands continue to grow/connect and surface ladder fuels continue to accumulate; it would be expected that there is a higher potential of moving fire type from surface to passive and active crown fire. This is shown in the change of surface fire short term vs. long term in this table.

Table 10. Fire Type Displayed in Acres – Alternatives 2 and 3 - Within Treatment Units

Fire Type in Acres – Short Term (5 Years) Post Treatment within treatment units			
Percentile Weather	Surface Fire	Passive Crown Fire	Active Crown Fire
90 th Percentile	3409 (77%)	708 (16%)	327 (7%)
Fire Type in Acres – Longer Term (20 Year) Post Treatment within treatment units			
Percentile Weather	Surface Fire	Passive Crown Fire	Active Crown Fire
90 th Percentile	1429 (32%)	2034 (46%)	981 (22%)

Table 10 is similar to Table 9 above; addressing the post treatment condition under 90% weather within the treatment units of the project boundary.

Flame Length Potential

Table 11. Flame Length Potential Displayed in Acres – Alternatives 2 and 3 – Entire Project Boundary

Flame Length Potential in Acres – Short Term (5 Years)Post Treatment				
Percentile Weather	Low (0-4')	Moderate (4-8')	High (8-11')	Very High (>11')
90th Percentile	6632 (56%)	1193 (10%)	667 (6%)	3318 (28%)
Flame Length Potential in Acres – Longer Term (20 Years) Post Treatment				
Percentile Weather	Low (0-4')	Moderate (4-8')	High (8-11')	Very High (>11')
90th Percentile	5446 (46%)	2217 (19%)	775 (7%)	3372 (28%)

Table 11 displays the post treatment condition under 90% weather within the entire project boundary for flame lengths (post treatment). This table also compares the changed conditions for short term and longer term conditions post treatments in Alternatives 2 & 3. Flame lengths are shown in 4 categories from low to very high. Certain fuel loadings and fuel models have materials such as brush and continuous slash accumulations that show higher flame lengths. These fuel models in the project area are referenced in Appendix A, Table A-2. Areas of the project that have a more open type of timber stand or less accumulations of fuels show higher flame lengths. As fuels continue to accumulate there is a higher potential of increasing flame lengths which could lead to undesirable effects if a wildfire were to occur.

Table 12. Flame Length Potential Displayed in Acres – Alternatives 2 and 3 - Within Treatment Units

Flame Length Potential in Acres – 5 Years Post Treatment within treatment units				
Percentile Weather	Low (0-4')	Moderate (4-8')	High (8-11')	Very High (>11')
90th Percentile	4049 (91%)	230 (5%)	50 (1%)	115 (2%)
Flame Length Potential in Acres - 20 Year Post Treatment within treatment units				
Percentile Weather	Low (0-4')	Moderate (4-8')	High (8-11')	Very High (>11')
90th Percentile	3050 (68%)	1144 (27%)	116 (2%)	134 (3%)

Table 12 is similar to Table 11 above; addressing the post treatment condition under 90% weather within the treatment units of the project boundary. Again this table shows the modeled difference in short and longer term results post treatment.

Fire Behavior on Vegetation Type and Size Class

Table 13: Short Term (5 Year) post treatment fire behavior potential (acres by flame length) by dominant vegetation type under 90th percentile weather conditions in the project area.

Dominant Vegetation Type	Low (0-4 feet)	Moderate (4-8 feet)	High (8-11 feet)	Very High (greater than 11 feet)
Annual Grass	76	11	6	5
Barren	90	0	0	0
Douglas Fir	763	137	59	783
Montane Chaparral	225	18	16	28
Montane Hardwood Conifer	519	53	35	182
Montane Hardwood	44	15	12	48
Montane Riparian	57	4	3	3
Perennial Grass	12	4	5	15
Ponderosa Pine	93	3	12	11
Red Fir	489	74	37	78
Subalpine Conifer	37	7	0	0
Sierran Mixed Conifer	2955	662	342	1818
Urban	43	3	0	0
White Fir	1268	189	132	308
Total	6671	1180	659	3279

The dominant vegetation type from the EVEG GIS layer was used for this analysis.

Table 14: Short Term (5 Year) post treatment fire behavior potential (acres by flame length) by tree size class under 90th percentile weather conditions in the project area.

Size Class (diameter)	Low (0-4 feet)	Moderate (4-8 feet)	High (8-11 feet)	Very High (greater than 11 feet)
1-5.9 inches	553	38	23	51
6-10.9 inches	585	74	43	170
11-23.9 inches	3338	523	336	1184
Greater than 24 inches	1874	513	234	1838
Total	6350	1148	636	3243

Table 15: Longer Term (20 Year) post treatment fire behavior potential (acres by flame length) by dominant vegetation type under 90th percentile weather conditions in the project area.

Dominant Vegetation Type	Low (0-4 feet)	Moderate (4-8 feet)	High (8-11 feet)	Very High (greater than 11 feet)
Annual Grass	57	28	7	5
Barren	90			
Douglas Fir	517	323	99	804
Montane Chaparral	177	62	18	30
Montane Hardwood Conifer	420	140	39	190
Montane Hardwood	49	23	13	49
Montane Riparian	54	7	3	4
Perennial Grass	9	5	5	17
Ponderosa Pine	70	23	15	11
Red Fir	469	87	40	81
Subalpine Conifer	37	7	0	0
Sierran Mixed Conifer	2343	1213	389	1832
Urban	41	4	0	0
White Fir	1173	276	138	310
Total	5506	2198	766	3333

The dominant vegetation type from the EVEG GIS layer was used for this analysis.

Table 16: Longer Term (20 Year) post treatment Fire behavior potential (acres by flame length) by tree size class under 90th percentile weather conditions in the project area.

Size Class (diameter)	Low (0-4 feet)	Moderate (4-8 feet)	High (8-11 feet)	Very High (greater than 11 feet)
1-5.9 inches	400	186	27	52
6-10.9 inches	490	160	48	174
11-23.9 inches	2757	1035	385	1204
Greater than 24 inches	1565	749	279	1865
Total	5212	2130	739	3295

Tables 13-16 display the post treatment condition under 90% weather within the project boundary. The results of modeling for short term and longer term change are displayed throughout tables 13-16. The dominant vegetation and size class are categorized from low to very high flame lengths.

Cumulative Effects

The proposed actions in alternatives 2 and 3 will have positive effects in reducing fire type, flame length potential, and fire effects to vegetation that will decrease over time. After 20 years there will be a need for re-entry to maintain the effectiveness of treatment. The two continuing projects adjacent to the Lover's Canyon analysis area will have an effect to large scale fire across the landscape. Fire starts within the Lover's Canyon may utilize the adjacent projects as strategic areas to slow or impede fire progress. These projects are the Westside Fire Recovery and Scott Bar Mountain Underburn and Habitat Improvement Project. Generally these two projects have fuels modification in the form of prescribed burning that will reduce adjacent fuels and provide areas that are more likely to have effective fire suppression response. In effect implementing the Lover's Canyon project would fill in a strategic gap of treatment between the wilderness, private ownership and aforementioned Forest Service projects adjacent. The combination of these activities would increase fire suppression capabilities, reduce overall fire size, reduce flame lengths, reduce crown fire potential, and reduce overall fire effects on the landscape. Outside of treatment areas, fire behavior potential is modeled to be similar to current conditions; although, fire spreading across the landscape could influence fire behavior in untreated areas.

Comparison of Alternatives for the Project Area

Tables 17 and 18 compare the potential flame length and fire type for the project area under Alternative 1 (no action) and Alternatives 2 and 3 (the action alternatives).

Table 17: Potential Flame lengths -- Comparison of Alternative 1 to short-term post-treatment of action alternatives

Flame Length	Alternative 1	Alternative 2/3 Short Term	Alternative 2/3 Longer Term
0-4 feet	3056 (26%)	6632 (56%)	5446 (46%)
4-8 feet	1498 (13%)	1193 (10%)	2217 (19%)
8-11 feet	1277 (11%)	667 (6%)	775 (7%)
Greater than 11 feet	5979 (50%)	3318 (28%)	3372 (28%)

Table 18: Potential Fire Types -- Comparison of Alternative 1 to short-term post treatment of action alternatives

Fire Type	Alternative 1	Alternative 3 Short Term	Alternative 3 Longer Tem
Surface	1,777 (15%)	5,141 (44%)	2,887 (24%)
Passive Crown	9,776 (83%)	6,607 (55%)	8,861 (75%)
Active Crown	257 (2%)	62 (1%)	62 (1%)

Tables 19 and 20 compare the fire behavior potential on dominant vegetation type and size class for the project area under alternative 1, and short-term post-treatment for Alternatives 2 and 3.

Table 19: Fire behavior potential on dominant vegetation types compared in short term (5 year) Alternative 1 compared to action alternatives

Dominant Vegetation Type	Alternative 1				Alternative 2/3			
	Low (0-4')	Moderate (4-8')	High (8-11')	Very High (> 11')	Low (0-4')	Moderate (4-8')	High (8-11')	Very High (> 11')
Annual Grass	8	16	14	25	76	11	6	5
Barren	90	0	0	0	90	0	0	0
Douglas Fir	228	168	127	1219	763	137	59	783
Montane Chaparral	142	35	53	56	225	18	16	28
Montane Hardwood Conifer	120	61	92	516	519	53	35	182
Montane Hardwood	29	10	13	71	44	15	12	48
Montane Riparian	40	2	12	12	57	4	3	3
Perennial Grass	7	3	6	19	12	4	5	15
Ponderosa Pine	23	7	21	68	93	3	12	11
Red Fir	419	130	29	103	489	74	37	78
Subalpine Conifer	30	13	0	0	37	7	0	0
Sierran Mixed Conifer	1,020	752	739	3267	2955	662	342	1818
Urban	30	0	10	4	43	3	0	0
White Fir	888	282	194	573	1268	189	132	308

Table 20: Fire behavior potential on size class compared in short term (5 year) Alternative 1 compared to action alternatives

	Alternative 1					Alternative 2/3			
Size Class (diameter)	Low (0-4')	Moderate (4-8')	High (8-11')	Very High (> 11')		Low (0-4')	Moderate (4-8')	High (8-11')	Very High (> 11')
1-5.9 inches	239	56	205	165		553	38	23	51
6-10.9 inches	232	72	142	426		585	74	43	170
11-23.9 inches	1447	637	620	2677		3338	523	336	1184
Greater than 24 inches	943	675	253	2987		1874	513	234	1838
Total	2861	1440	1220	6255		6350	1148	636	3243

Modeling indicates that the majority of the treatment area would meet desired conditions and slowly trend toward existing conditions over the modeled 20 year period. Ladder and crown fuels would be reduced through thinning of the stands. Activity fuels (slash generated from harvest and thinning activities) would be treated through a variety of methods including yarding methods, and prescribed fire techniques such as broadcast burning and piling and burning. The reduction of surface fuels would reduce the potential flame length within the proposed treatment units. This when combined with the raising of the canopy base heights by reducing the ladder fuels would in turn, reduce the ability of a fire to transition into a crown fire. As a result, fire effects in treated units would be reduced in all vegetation types and size classes.

Thinning of overstocked small-diameter understory stands would reduce the ladder fuels allowing fire to remain in the surface fuels, and reducing the potential for crown fire.

Suppression operations would continue to occur, however, fire behavior modeling indicates the proposed action would keep the fuels profile at a level that reduces fireline intensity allowing suppression resources to more safely use direct suppression tactics on a much larger percentage of the project area.

Compliance with Law, Regulation and Policy

The treatments of all action alternatives meet the Klamath National Forest Land and Resource Management Plan (USDA 1995, as amended) as well as the recommendations within the Lower Scott Watershed Analysis.

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Appendix A: Fire and Fuels Modeling Description

Model Description

Flammap

Flammap is a fire behavior mapping and analysis program that computes fire behavior characteristics over a landscape of constant inputs of weather and fuels moisture conditions. Outputs consisted of fire type or crown fire potential (Scott and Reinhardt, 2001) and flame length potential (Finney 1998). In addition, all fire model runs were calculated using the California Fuels Landscape, which uses the vegetation layer to obtain fuel models. In addition to fuel models, the California Fuels Landscape is comprised of elevation, aspect, slope, canopy cover, stand height, canopy bulk density, and canopy base height to predict fire behavior potential.

Flammap employs the fire behavior model of Rothermel 1972. The Rothermel fire behavior model makes several assumptions such as: 1. The fire is free burning, 2. Fire behavior is predicted at the flaming front, 3. Fine fuels are the primary carrier of the initial fire front, and 4. Fuels are continuous and uniform.

Fire type is a measure of how severe a fire may become under specified conditions. Canopy characteristics (e.g. canopy base height, canopy bulk density, stand height, and foliar moisture content), ladder fuels, and fuel loading are all factors that determine fire type. The model assumes uniform canopy characteristics and makes independent fire behavior calculations for each raster landscape (90 m X 90 m cell). As a result of these assumptions, the model frequently under-predicts active crown fires (Fule et al., 2001; Scott and Reinhardt, 2001; Cruz et al., 2003; and Stratton, 2004) compared to field observations.

Fire behavior outputs generated from modeling exercises only reflect static conditions and do not take into account changing weather conditions. Any change in these factors could drastically affect fire behavior. Given the uncertainty of any modeling exercise, the results are best used to compare the relative effects of the alternatives, rather than as an indicator of absolute effects.

Weather and fuel moisture conditions were calculated by a climatology program (Fire Family Plus) that collects historical weather data for analysis. Historical weather data was obtained from Slater Butte and Collins Baldy Remote Automated Weather Stations (RAWS). Both 50th and 90th percentile weather conditions were input into Flammap for analysis of fire behavior potential. These weather scenarios are described in table A-1.

Table A-1 Parameters used for modeling under 90% weather conditions.

	Weather Under 90th Percentile Conditions
<i>Parameter</i>	<i>90th Percentile</i>
Woody Fuel Moisture (%)	69
Herbaceous Fuel Moisture (%)	30
1000 Hour Fuel Moisture (%)	7
100 Hour Fuel Moisture (%)	6
10 Hour Fuel Moisture (%)	4
1 Hour Fuel Moisture (%)	3
Wind Speed (MPH)	9

Weather derived for 90th percentile weather conditions were based on fire season. The fire season can be defined by four primary fire behavior/fire danger periods: low, moderate, high, and very high. Low and moderate is not included in this analysis because wildfire events are not common and the amount of effort needed to suppress fires is typically low. Very high fire danger periods occur under 90th percentile weather conditions, or weather conditions that make up 10% of the days of the historical fire seasons, and large fire growth can generally be expected during these days. For the analysis of the Lovers Canyon, 90th percentile weather scenarios were calculated for analysis based on historical weather from Quartz Hill and Collins Baldy Remote Automated Weather Stations from May 15 to October 31.

Fuels

To model and predict fire behavior, fuels are often broken into fuel models that are mathematically put into a fire spread calculation (Rothermel 1972). Geographic information system layers of the Landfire Landscape (i.e., fuel models derived from the vegetation layer) were obtained to analyze current fuel models within the project boundary. The fuel models (Scott and Burgan, 2005) within the project boundary are described in Table A-2.

Table A-2: Acres and percent by individual fuel model type throughout the entire project boundary.

Fuel Model and Category	Description	Acres of fuel model in project area	Percent within project area
Non-Flammable Fuel Models			
99	Non-Flammable. For example, open water, urban development, or bare ground	197 Acres	2%
Grass Fuel Models			
101 -- GR1 102 -- GR2	The primary carrier of fire is sparse grass, though small amounts of fine dead fuel may be present.	503 Acres	4%
Grass-Shrub Fuel Models			
121 -- GS1 122 -- GS2	The primary carrier of fire in GS1 and GS 2 is grass and shrubs combined. Spread rate is high; flame length moderate.	1052 Acres	9%
Shrub Fuel Models			
142 -- SH2 143 -- SH3	The primary carrier of fire in SH2 and SH3 is woody shrubs and shrub litter. Moderate fuel load (higher than SH1), depth about 1 foot, and no grass fuel present. Spread rate is low; flame length low.	157 Acres	2%
147 -- SH7	The primary carrier of fire is woody shrubs and shrub litter. Very heavy shrub load, depth 4-6 feet. Spread rate lower than SH5, but flame length similar. Spread rate is high; flame length very high.	137 Acres	1%
Timber-Understory Fuel Models			
165 - TU5	The primary carrier of fire in TU5 is heavy forest litter with a shrub or small tree understory. Spread rate is moderate; flame length high.	5972 Acres	50%
Timber-Litter Fuel Models			
183 -- TL3	The primary carrier of fire is moderate load conifer litter, light load of coarse fuels. Spread rate is very low; flame length low	204 Acres	2%
186 -- TL6	The primary carrier of fire in TL6 is moderate load broadleaf litter, less compact than TL2. Spread rate is moderate; flame length low.	113 Acres	1%
188 -- TL8	The primary carrier of fire in TL8 is moderate load long-needle pine litter, may include small amount of herbaceous load. Spread rate is moderate; flame length low.	3450 Acres	29%
Other Fuel Models			
Other	Other fuel models within the analysis boundary less than 100 Acres and make up a small percentage of the total area.	24 Acres	<1%
Descriptions based on Anderson 1982 and Scott and Burgan 2005. Fuel models derived from the California Fuels Landscape created by the Region 5 Stewardship and Fireshed Analysis Team and clipped to the analysis area in GIS.			

Appendix B - Fire Regime and Historical Reference Conditions (Condition Class)

A natural fire regime is a general classification of how fire played a role in an ecosystem in the absence of modern human intervention but including the influence of aboriginal burning (Agee, 1993). Coarse-scale definitions of fire regimes have been provided by Hardy et al. 2001 and Schmidt et al. 2002 and interpreted for management of fire and fuels (Hann and Bunnell, 2001). The five natural (historical) fire regimes as described by historical fire frequency (average number of years between fires) and historical fire severity (the effect of the fire on dominant overstory species) are described in the following table.

Table B-1: Description of historic natural fire regimes

Historical Natural Fire Regimes	
Code	Description
I	0–35-year frequency ^a , low and mixed severity ^b
II	0–35-year frequency, stand-replacement severity
III	35–100+ year frequency, low and mixed severity
IV	35–100+ year frequency, stand-replacement severity
V	200+ year frequency, stand-replacement severity
a- Fire frequency is the average number of years between fires. b- Severity is the effect of the fire on the dominant overstory vegetation.	

Historical and current vegetation classes are primarily conifer, mixed-conifer, and mixed-conifer and hardwood; however, differences in seral stage distribution have changed through time. The mean historical fire return interval within the Lovers Canyon project boundary ranges from approximately 11 years to over 100 years, depending on biophysical setting. A biophysical setting is defined as a combination of vegetation and topographic features, soils, and climate variables that influence vegetation development. As depicted below, approximately 98 percent of the landscape supported vegetation at or below a fire return interval of 30 years.

Table B-2: Historic fire return intervals in the project area

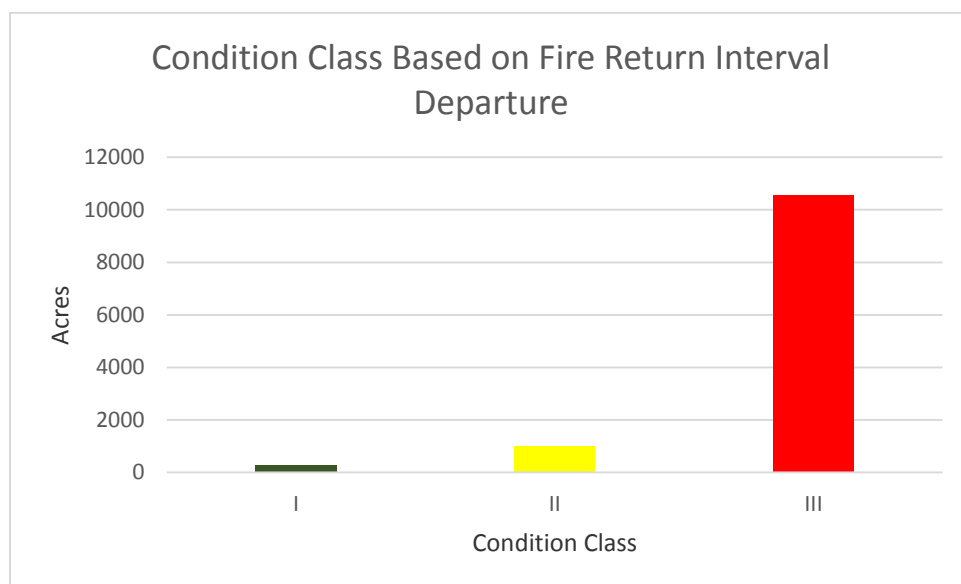
Historic Fire Return Intervals in years	Acres	Percent of Area
Less than or equal to 15	10540	90
Greater than 15 and less than or equal to 30	1001	8
Greater than 30	269	2
Total	11,810	100

An analysis was conducted to compare historical fire return intervals (pre-suppression) to contemporary fire return intervals (suppression era) over the analysis area. This analysis is known as condition class based on departure from the historic fire return interval.

The following equation is used to determine the departure of fire return intervals:

$\{1 \text{ minus (reference fire return interval divided by current fire return interval)}\} \text{ times } 100$

The value obtained is a percent difference, and condition class is determined using the LANDFIRE national scale (i.e., zero to less than 33 percent departure equals condition class 1, 33 to less than 67 percent departure equals condition class 2, and greater than 67 percent departure equals condition class 3).

**Figure B-1: Historical reference conditions (condition class) based fire return interval departure**